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Controlling the metal insulator transition using the ferroelectric field effect in rare earth nickelates[1] MATTHEW MARSHALL, ANKIT DISA, DIVINE KUMAH, HANGHUI CHEN, SOHRAB ISMAIL-BEIGI, FRED WALKER, CHARLES AHN, Department of Applied Physics and Center for Research on Interface Structures and Phenomena (CRISP), Yale University — A ferroelectric field effect transistor (FE-FET) modulates conductivity in a non-volatile manner by electrostatically accumulating and depleting charge carriers at the interface between a conducting channel and ferroelectric gate. The rare earth nickelate $LaNiO_3$ is metallic in bulk, while other rare earth nickelates, such as $NdNiO_3$, exhibit metal-insulator transitions and anti-ferromagnetic behavior in the bulk. Here, we show that by coupling the ferroelectric polarization of $Pb_{0.8}Zr_{0.2}TiO_3$ (PZT) to the carriers in a nickelate, we can dynamically induce a metal- insulator transition in ultra-thin films of LaNiO3, and induce large changes in the MIT transition temperature in NdNiO3. Density functional theory is used to determine changes in the physical and electronic Ni-O-Ni bond angle of the nickelate at the interface between PZT and LaNiO3. The effect of the ferroelectric polarization is to decrease the Ni-O-Ni bond angle from 180 degrees and increase the carrier effective mass. Related to this change in electronic structure, we observe a change in resistivity of approximately 80% at room temperature for an ultra-thin 3 unit cell thick film of $LaNiO_3$.

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